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THE DETERMINATION OF THE COOKING QUALITY OF POTATOES

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Since the days of Sir Walter Raleigh, the humble potato has become a cosmopolitan article of diet. Potatoes are eaten by rich and poor, landlord and tenant. Until the present time we have been content to purchase them on appearances only, whereas several other articles for human consumption are graded on a quality basis, such as eggs, meat and wheat. Quality should be the foundation of our potato grades, because the actual food value of potatoes is of more importance to us than grades that are based on size, appearance, freedom from disease and injury. Potatoes can now have their quality indicated on the grade tag, since a quick method of determining their dry matter has been developed by the Certified Seed Potato Inspection Service in cooperation with the Dominion Laboratory of Plant Pathology at Saanichton, B. C. Tests conducted during the past four years have shown that the total dry matter content indicates quality. Therefore, a 15 per cent dry matter is associated with poor quality, whereas a 30 per cent dry matter content indicates that the sample of potatoes is of excellent quality. There is also a range of quality between these low and high readings, from "poor" to "fair," "good" and "excellent."

Results of investigations made previously at the laboratory to determine the cooking quality of potatoes have not been available to the general public, nor have they been used to assist the consumer in securing good quality potatoes. Consequently we find many samples

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of potatoes offered for sale which obviously have very poor cooking qualities. They are dark in color, soggy, disintegrate when boiled, or have an unpleasant flavor. Possibly before we discuss how these undesirable factors are determined scientifically, and how potatoes could be marked to indicate the quality of the package offered for sale, a discussion on quality would be of interest.

E. M. East, Illinois Agricultural Experiment Station, states "that in France, sogginess is desirable, since the accepted method of cooking is deep fat frying, for which a tuber which holds its form is desired. In America, probably 90 per cent of the consumption is of boiled or baked potatoes, which are desired dry and mealy."

C. F. Langworthy, U. S. Department of Agriculture, defines and explains mealiness as follows: "In this country the chief test of excellence is mealiness, which means that, when cooked, a potato should form a crystalline-like mass, with almost distinct starch-like particles. This quality depends largely upon the proportion of starch present. If it is abundant and evenly distributed throughout the tuber the cells burst open in cooking, and a light flaky, uniform mass results. If the proportion of starch is small in any part of the potato, water is likely to replace it, which will make the potato soggy when cooked."

With the objective in view of developing a method whereby the quality of potatoes could be determined quickly and accurately, a series of tests was conducted over a period of four years. These tests were divided into three sections as follows: first, cooking of samples of potatoes by boiling, baking, steaming and deep fat frying; secondly, by the determination of their dry matter content; and thirdly, by the determination of their specific gravity.

Cooking of Potato Samples to Determine Quality

The old adage that "the proof of the pudding is in the eating," applies to potatoes as well as to other commodities. A cooking test indicates quality, as most defects are apparent when the potatoes are boiled. If the total dry matter is low, the cooked sample will probably be soggy, and the tubers will turn dark when taken from the stove and drained. If the potato sample is high in dry matter it indicates a high starch content and potatoes of this nature are liable to boil away or slough. Most of our potatoes with a high dry matter content have a tendency to slough if boiled vigorously, but many of them will retain their form if brought to a boil and then allowed to simmer. Potatoes which tend to slough may be cooked much

better in a steamer where they will cook just as quickly as they do in boiling water. Although potatoes of poor quality will bake, they are often quite soggy and may have hard lumps in them. Potatoes of high dry matter content, on the other hand, usually bake well. It was found that the poor quality potatoes were almost as good as those of good quality for deep fat or French frying, so far as appearances were concerned.

Even though cooking tests reveal quality in potatoes, the final judgment of quality rests with the consumers who eat them. If the quality is poor, consumption decreases. If the quality is good, the amount of potatoes eaten tends to increase. In conducting cooking tests the score card method of analysis was adopted. The following points were considered—ease and uniformity of cooking, form when cooked (sloughing or retaining form); texture, mealy or soggy; color of flesh when pared, cooked and after standing overnight; grain when mashed, fine, medium or coarse; flavor, strong, flat or mild.

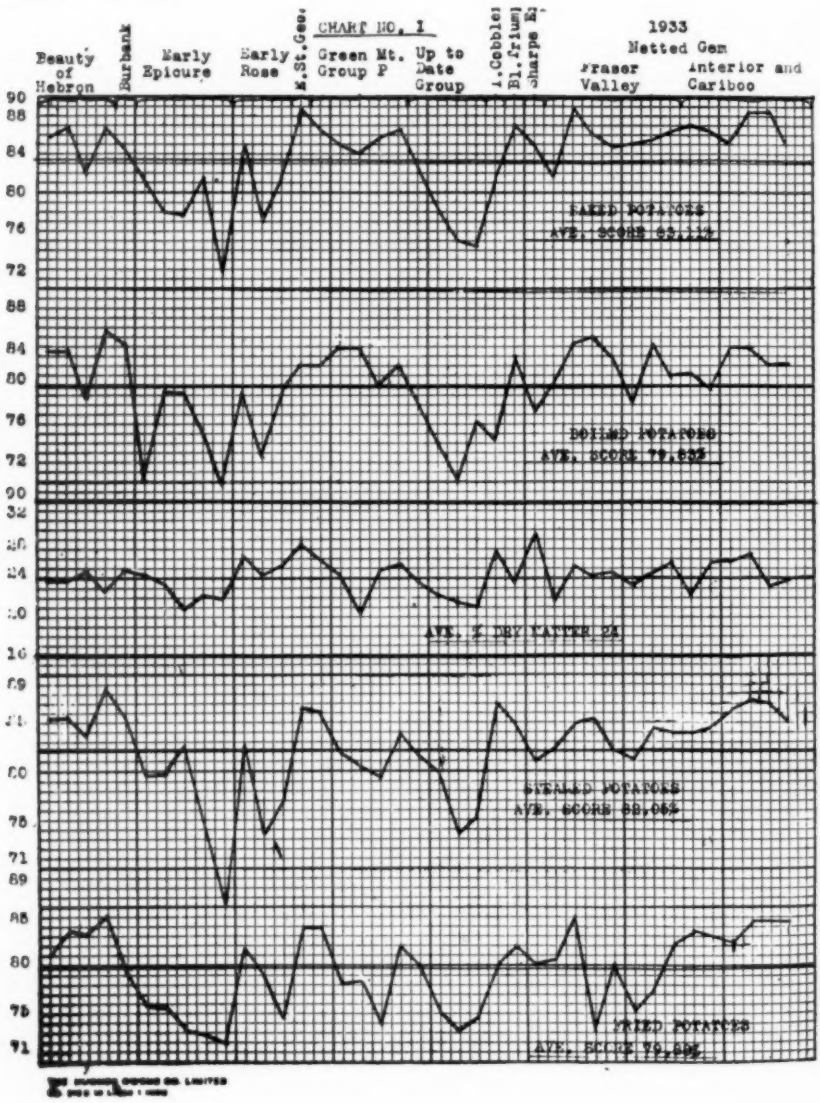
Points to Consider	Possible Score	Score (Revised)	Score Awarded	Explanation of Points
Ease of cooking.....	5	5	———	Average time at cooking, temp. 25 to 40 min.
Uniformity of cooking	5	5	———	Cooking uniformly in same time and at same temp.
Form when cooked...	10	5	———	Breaks to pieces, much sloughing, little or no sloughing.
Texture of flesh.....	20	20	———	Very soggy, soggy, slightmealy, mealy, or very mealy.
Color of flesh..... (Varietal)	5	5	———	White, creamy, gray or dark.
Grain when mashed...	10	10	———	Very coarse, coarse, medium, or fine.
Color of flesh cooked and mashed.....	15	15	———	Very dark, dark, gray, yellow, or white.
Color of flesh after standing overnight..	15	15	———	Very dark, dark, gray, yellow, or white.
Flavor	15	20	———	Strong, slightly strong, flat, mild, distinctive potato flavor.
Total....	100	100	———	

The use of score cards tends to standardize cooking methods and make them reliable but the method is rather slow. The score is also an arbitrary estimation and consequently liable to error.

It is not practical to secure samples of potatoes and make cooking tests especially when they are bought in small quantities as the source of the potatoes may vary each week. This method can however be used to advantage where the consumer is buying direct from the producer.

Determination of Dry Matter

Dry matter tests were adopted as the second method and the results were compared with the cooking tests. (See chart No. 1 which shows how the cooking quality of potatoes is influenced by the dry matter content).



The dry matter content was determined by weighing fifty grams of sliced potatoes both before and after drying of the samples in an oven at 80° to 100° C. When tables, showing the dry matter, were compared with tables giving the cooking scores, it was found that there was a high degree of association between them. In general, low cooking scores were associated with low dry matter and high cooking scores with high dry matter. Potatoes below 20 per cent dry matter were generally of "poor quality." They were wet and soggy and turned dark when allowed to stand overnight, especially those from peat soils. Potatoes with a dry matter ranging from 20 to 23 per cent were "fair" in quality, but had a tendency to turn dark when grown on bottom lands or silt-peat soils. With a dry matter content between 23 and 26 per cent, the potatoes were of "good" quality. Potatoes of this nature were, for the most part, grown upon the sandy or silt loams. Those from the Interior of British Columbia were of especially good quality. These were grown on the silt soils, high in calcium and potash. These samples had dry matter contents of 26 per cent or more and were of "excellent quality." They remained a good color for several days after being cooked. The average dry matter of samples tested during the four year period was 24 per cent. These results indicated that dry matter tests may be used as a guide to the purchaser in selecting quality in potatoes. The determination of dry matter in an oven is a very slow process. It takes from two to three days to complete a test, but several samples may be completed at one time. A statistical analysis showing association of dry matter in cooking scores is shown in table 1.

TABLE 1.—*Analysis showing association of dry matter in cooking scores*

	Baked	Boiled	Steamed	Fried	Aver. Score
Dry Matter	.402±.09	.177±.104	.40±.09	.384±.091	.398±.09

These coefficients of correlations show a moderate degree of association between dry matter and the baked, steamed and fried tests, with a low degree of association between dry matter and the boiled tests. The average score shows a moderate degree of association with a low P. E. between the dry matter and cooking scores. The present data indicate that as the dry matter content increases, sloughing increases, and that as the dry matter content decreases the sloughing decreases. Sloughing being considered detrimental, was the cause of many scores being lowered and vice-versa.

TABLE 2.—*Coefficients of correlation between dry matter and other factors in boiled potatoes*

	Form	Texture	Color A	Color B	Flavor
Dry M.....	—.30±.098	.45±.086	.165±.104	.125±.106	.24 ±.101
Form	.....	.20±.104	.317±.097	.122±.107	.405±.09
Texture	.....	.....	.413±.089	.312±.097	.568±.072
Color A	.....	.....	.....	.842±.031	.803±.038
Color B	.....	.....	.....	.....	.608±.068

Table 2 shows one negative result, that of —.30±.098 between dry matter and form or sloughing, a very low or negligible degree of association. This result agrees with the low degree of association between dry matter and the total score of the boiled potato test .177±.104. It also agrees with the low degree of association found by Child and Willaman of .131±.168. They state that "In the data studied there is no evidence for the cause of sloughing. It is apparently not a question of dry matter, at least within the range studied." But an examination of their score card shows, that the higher the dry matter scores, the lower the score on form or sloughing, whereas those with low dry matter scores are the ones to score high on sloughing. These results indicate that sloughing accompanies *"good* quality." We should possibly reverse our score card on this point, or lower the points awarded for sloughing to five points. This would allow *"good* quality" to score higher, and reduce the scores of the *"poor* quality" potatoes. If the scores on sloughing were reversed, there would be a high degree of association between dry matter and sloughing.

DETERMINATION OF SPECIFIC GRAVITY

In order to develop a quicker method of determining quality in potatoes, the specific gravity of several samples was determined and the results compared with the dry matter contents of the same samples. Association of dry matter and specific gravity in fourteen samples (from 1935 tests) = r = .823 ± P.E. = .0546.

The specific gravity of any article is the relation of its weight to that of water. Gasoline, oils and fats are lighter, whereas metals are heavier, many of them being several times heavier than water. Potatoes are slightly heavier than water and by measuring this difference in weight their specific gravity is secured. The specific gravity is influenced by the amount of starch, protein and minerals present. By comparing the weight of potato samples as ordinarily taken with the weight when suspended in water, any variation in the specific gravity is secured. Then by the use of tables which have been prepared from testing a large number of samples for both dry matter and specific gravity, the dry matter reading of any sample may be secured rapidly.

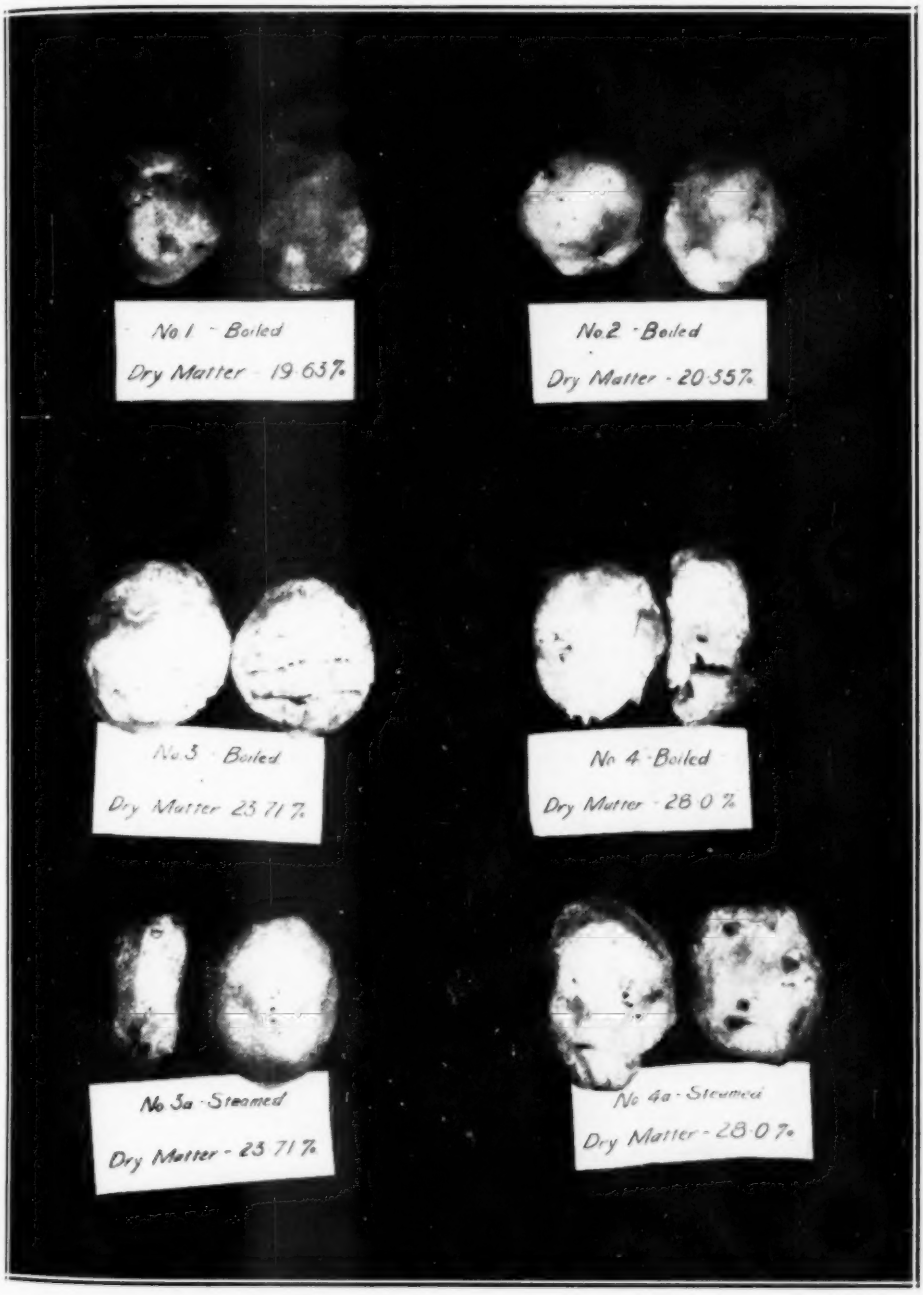


FIG. 1.—COOKED POTATOES, SHOWING IMPROVEMENT IN COLOR WITH INCREASE IN DRY MATTER CONTENT

The photograph in figure 1 of cooked samples of potatoes shows how the low dry matter samples turn dark after being cooked and allowed to stand, also how the color of the cooked potatoes improves as the dry matter content increases. The boiled potatoes in samples 3 and 4 show how the higher dry matter content potatoes tend to slough: sloughing was not noticeable in samples 1 and 2. Samples labeled 3a and 4a were steamed, and this process prevented sloughing. They showed some dark coloring around the edges but this was from a slight yellowing which often develops when the potatoes are steamed, but does not show when the potatoes are mashed, whereas samples 1 and 2 turned dark even after being mashed.

Conclusions

In this discussion on the cooking quality of potatoes, we have shown that although potatoes are an important article in our diet, their quality is not taken into consideration in the potato grades. Quality in potatoes has been associated with dry matter content, therefore, a high dry matter content of 30 per cent is associated with "*good* quality" and a low dry matter content of 15 per cent with "*poor* quality." A practical way of getting at the dry matter content is to determine the specific gravity and secure the dry matter content from tables prepared from many tests. This method is rapid and practical, and its application for determining quality in potatoes is recommended. When the quality of the potatoes sold, as indicated by the dry matter content, is given on the grade tag the consumer will have a better idea of what he or she is going to have for dinner.

VARIATIONS IN NYMPHAL POPULATIONS OF THE POTATO LEAFHOPPER ON DIFFERENT VARIETIES OF POTATOES

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In Ohio it has been observed that some varieties of potatoes are seriously injured by the potato leafhopper, *Empoasca fabae* Harris; whereas other varieties show relatively light damage. Bliss Triumph and Irish Cobbler are typical of the former, and members of the Rural group typical of the latter.

Note: The equipment for determining the specific gravity and dry matter content was patterned after the illustration in U. S. Department of Agriculture Bulletin (Farmer's) No. 410. 1910.

Population studies were made on a number of varieties grown at the Muck Crops Experiment Farm in Hardin County, Ohio, during the summer of 1936 in an attempt to determine whether there are specific varietal differences in leafhopper populations. Data are presented in this paper which indicate that the number of leafhopper nymphs varies significantly for the different varieties.

Fifteen varieties were grown in single-row, 50-hill plots, each of which was replicated five times in randomized blocks. All varieties were planted on the same date and were not sprayed during the entire season. Five varieties planted three weeks earlier in a complementary block were also observed.

The method used in determining leafhopper populations was to count the nymphs on 40 leaves selected at random from each plot. Nymphs seldom leave the plant and may be readily counted upon an individual leaf. The adults, however, are very active and move freely from one plant to another and from row to row. Therefore, the nymphal count was considered the better index of relative populations.

Inasmuch as it was observed that the season of leafhopper abundance varied for the several varieties studied, it was deemed important to consider the factor "days to maturity" in evaluating the results of this study. "Days to maturity" for each variety was calculated from the time of planting to the time when the majority of the leaves were dead.

TABLE 1.—*Number of leafhopper nymphs counted on July 20 per 10 leaves on potatoes planted May 25.*

Variety	Replicate					Mean	Days to Maturity
	A	B	C	D	E		
Giant-hill Rural	3	4	3	5	8	4.6	130
Russet Rural	11	3	4	6	6	6.0	120
McCormick	8	4	3	11	8	6.6	130
Brown Beauty	9	4	6	10	8	7.4	115
Early Ohio	10	4	8	7	13	8.4	90
Green Mountain	9	15	6	8	6	8.8	120
Spaulding Rose	21	8	6	7	6	9.6	120
Russet Burbank	13	14	11	12	11	12.2	120
Katahdin	27	7	8	13	10	13.0	115
Peachblow	17	7	7	19	28	15.6	115
Chippewa	46	7	9	11	14	17.4	100
Jersey Red	7	39	13	13	24	19.2	130
Warba	51	23	22	19	29	28.8	85
Irish Cobbler	41	28	30	30	29	31.6	90
Bliss Triumph	101	61	18	22	28	46.0	90

TABLE 2.—*Number of leafhopper nymphs counted on July 6 per 10 leaves on potatoes planted May 5.*

Variety	Replicate						Mean	Days to Maturity
	A	B	C	D	F	F		
Russet Rural	22	27	25	18	16	23	21.8	120
Chippewa	12	22	23	51	18	36	27.0	100
Irish Cobbler	45	62	26	36	21	37	37.8	90
Warba	23	40	41	28	34	93	43.1	85
Bliss Triumph ...	67	47	108	80	97	68	77.8	90

It will be seen from the data presented in tables 1 and 2 that Bliss Triumph exhibited, on July 6 and July 20, a much higher population than any of the fourteen remaining varieties. The application of Fisher's Z test to the data showed significant differences in leafhopper populations. In making mean comparisons, the analysis of variance indicated that a difference of 14.7 between mean populations was required to give odds of 19 to 1. It will be noted that the early maturing varieties, with one exception, were significantly more heavily populated than the late maturing varieties. The population on Early Ohio was lower than expected, considering preliminary observations made in 1935. The simple correlation between population and maturity, $r = -.67$, is significant.

TABLE 3.—*Number of leafhopper nymphs counted on August 27 per 10 leaves on potatoes planted May 25.*

Variety	Replicate					Mean	Days to Maturity
	A	B	C	D	E		
Brown Beauty	15	20	26	25	13	19.8	115
Russet Rural	8	21	23	24	25	20.2	120
Green Mountain	13	24	23	28	23	22.2	120
Peachblow	24	19	19	37	21	24.0	115
Giant-hill Rural	32	28	20	25	19	24.8	130
McCormick	25	22	29	31	19	25.2	130
Jersey Red	27	32	28	27	15	25.8	130
Russet Burbank	23	28	31	25	24	26.2	120
Katahdin	20	25	37	30	30	28.4	115
Spaulding Rose	30	18	39	26	32	29.0	120

It might be concluded from the data presented in tables 1 and 2 that the late maturing varieties were resistant to leafhopper attack,

but such a contention is not supported by the counts made on August 27 (table 3). At that time the surviving varieties showed uniformly greater populations than were exhibited six weeks earlier, and at the same time there was a decrease in the degree of variability among varieties. Analysis of the data shows that none of the late maturing varieties exhibited a restriction in population sufficient to indicate actual resistance to leafhopper attack when allowance is made for the influence of maturity. That is, none of the varieties carried a population which was lower than that expected, on the basis of maturity; therefore genetic resistance to attack by the leafhopper was not indicated. On the other hand, it will be noted that Bliss Triumph showed a higher population than was expected on the basis of maturity, which indicates that this variety is susceptible to attack.

DEVELOPMENTS IN POTATO FERTILIZER INVESTIGATIONS IN 1936*†

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This report summarizes the work published during the current year on nutrition, fertilization and soil fertility studies in their direct application to potato production. Original papers which have been published in the American Potato Journal and those which were reviewed by the committee and published during the current year in the Journal are not considered in this discussion. Although many periodicals have been covered in this review it is not claimed to be complete. Many references which have not been abstracted in this review are included in the bibliography with the literature citations.

Opitz and Rathsack (38) conducted plot experiments in Germany on a slightly loamy soil poor in humus, pH 5-6, in which straw was used at the rates of 2¼, 4½ and 9 tons to the acre, alone and in combination with a complete fertilizer. The yields were depressed with all straw applications.

Experiments by Berkner (6), also conducted in Germany, on the effect of manure with 24.2 per cent dry matter, 0.57 per cent N, 0.40 per cent P_2O_5, 0.78 per cent K_2O and 0.69 per cent CaO applied at rates of 9, 18, 36 and 72 tons to the acre in a rotation of potatoes,

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†Paper No. 158, Department of Vegetable Crops, Cornell University, Ithaca, New York.

spring wheat and barley, with a complete fertilizer also for the cereals, indicated that potato yields were increased progressively with manure. The highest yield was about 30 per cent over the unmanured plots but the percentage and total yield of starch were at a maximum with 18 tons of manure and declined with heavier applications.

Bushnell (12) reported that corn as a green manure has given larger amounts of organic matter to plow under and has resulted in larger yields of potatoes than have soybeans or sweet clover. The superiority of the corn seems to be caused by the larger amount of organic matter supplied, but its slower decomposition may also be a factor. No serious practical problem has arisen from the nitrogen deficiency resulting from plowing under large amounts of low nitrogen organic matter. The requirements of the potatoes have been met by including 40 to 80 pounds of N to the acre in the regular potato fertilizer.

Odland (36) states that over a forty year period the yields of potatoes have averaged about the same in the five systems of rotations tested. These include 3, 4, 5 and 6 year rotations with such crops as legume and non-legume hays, corn and rye as well as potatoes. Heavy applications of nitrogen appear to have caused slight decreases in yields. High potash applications have markedly increased yields whereas heavy phosphorus applications have increased yields but little over those receiving half as much. Although increasing the fertilizer from 1000 to 1500 pounds to the acre for potatoes has been profitable, there was no additional profit when a ton was used.

Source of potash from kainit, muriate, sulfate and sulfate of potash-magnesia has had little effect on yields.

The response to magnesium applied on unlimed acid soils has been very striking.

During the past five years extensive experiments have been conducted in Virginia by Carolus and Brown (13) to determine the best methods for correcting and preventing deficiencies of magnesium in the soil solution at the time the various crops have the most concentrated magnesium requirement. The potato plant has a definite period in its growth during which its magnesium requirement is very high and if the material is not available at that time chlorosis, or a mottled yellowing, occurs in its lower foliage. The inclusion of magnesium in potato fertilizers increased the yield as much as 25 barrels to the acre with an average increase on thirteen farms of 6.8 barrels to the acre. It was found that the potato, because of its rather slow growth during the first thirty to forty days after planting, was able to obtain an

adequate supply of magnesium from limestone included in a physiologically neutral 6-6-5 fertilizer. Fertilizers neutralized with dolomitic limestone, that was fine enough so that 80 per cent of it would pass through a 100 mesh sieve, gave the most satisfactory response with a minimum of leaching.

In field experiments on well manured soil in Germany, Berkner (5), found that the acid fertilization with $(NH_4)_2\ SO_4$, K_2SO_4 and superphosphate resulted in a 14 per cent greater yield than the alkaline fertilization with $Ca(NO_3)_2$, 40 per cent K_2O salt and basic slag carrying equivalent elements. Liming depressed the yields somewhat with the acid and increased them with the alkaline fertilizer. The former effect is attributed to neutralization, the latter to increase in availability of N. Scab was increased by the alkaline fertilizer and also by liming. The acid fertilizer with manure produced most sound tubers, whereas, on the other hand, manure seemed to decrease scab with the alkaline fertilizer. Liming apparently reduced trouble from rustiness although the reason for this is not clear.

Smith and Moore (46) and Smith (45) reported results of four years' field experiments with potatoes grown on soils ranging in reaction from pH 4.68 to pH 8.43 showing that the optimum soil reaction under these conditions for greatest yields has been between pH 4.8 and pH 7.9 depending upon seasonal weather conditions. The production of scabby tubers increased with increase in soil pH to pH 6.9 to 7.9 and then markedly decreased in more alkaline soils.

Klapp, Morgenweck and Spennemann (26), working in Germany, have shown that the starch content and dry weight of potatoes decreased with the stickiness of the soil as well as with increasing sand content. The highest yields of starch were obtained in neutral or weakly alkaline soils. Increased yields were obtained in soils with an abundance of lime present. No correlation was obtained between the starch content of the potatoes and the nutrient content of the soils.

Although increased yields were obtained by Engels (17) with either granulated or ground $CaCn_2$, the starch content of the potatoes was reduced from 15.8 to 15.1 per cent when the granulated material was used and to 14.9 per cent when the powdered material was used.

Experiments in England (49) have shown that normal crops of potatoes were produced on soils infested with *Heterodera schachtii* after the application of $CaCn_2$ at the rate of 1000 pounds to the acre but the treatment did not appreciably reduce the numbers of cysts on

the roots. The good results from $CaCn_2$ appeared to be caused by the amount of N rather than by any lethal effects of the chemical on the eelworms.

Emmert (16) working in Kentucky, concludes that with the high moisture, longer days and slightly higher temperatures during growth of the spring crop, it probably is an advantage to have the nitrogen values above 1000 p.p.m. at all times and phosphorus above 200 p.p.m. during the rapid growth and tuberization period but not during the early vegetative period.

In the fall crop, with shorter days, slightly lower temperature and reduced moisture there seems to be no advantage in maintaining N above 1000 p.p.m or phosphorus above 200 p.p.m. It is apparent that high moisture and N in the early stages produce a large leaf area which requires large amounts of water to maintain normal transpiration. If drought occurs. this stimulated leaf area is harder on the yields than if lower N levels had restricted leaf area. With a smaller leaf area, less transpirational water would be needed and more water could be used for tuber production.

Blair and Prince (9) found that potatoes require comparatively small amounts of phosphorus so far as the actual amount removed by the crop is concerned but note is made of the fact that in highly acid soils, such as are used for potatoes in New Jersey, much iron and aluminum are brought into solution and these iron and aluminum compounds react with soluble phosphates to form difficulty soluble iron and aluminum phosphates. This condition seems to make it necessary for the potato grower to renew the supply of soluble phosphates constantly.

The cultivated and uncultivated, unfertilized soils from the potato areas do not differ greatly in their content of potash, notwithstanding the fact that potash has been used liberally in potato fertilizers for a good many years.

A depletion of the organic matter is also noted when soils that are continuously cropped and fertilized are compared with corresponding soils not fertilized and cropped.

Harrington (20) noted that the use of nitrogen alone delayed maturity; increasing the potassium content of the soil resulted in delayed maturity and an immature crop at harvest time. Phosphorus, on the other hand, hastened maturity. Maturity was delayed most when nitrogen and potassium were used in combination.

Phosphorus distinctly increased the netting of russet varieties, whereas increased nitrogen resulted in poor netting and the addition of potassium almost eliminated the netting.

Phosphorus additions resulted in an increased percentage of No. 1 grade tubers.

Zharikov (53) found that the application of sylvinite to a podzolic sandy soil increased the active acidity by replacing the H ions, decreased the Ca and Mg in the soil complex of the upper horizon, decreased the nitrification energy and prevented the absorption of Ca and Mg by the potato, thereby decreasing the yield. The injurious effects of this KCl, bearing mineral could be avoided by applying it in the fall.

Böning (10) reported that potato plants which received K as chloride developed more severe symptoms of leafroll and streak disease than did those which received K as nitrate or sulfate.

A measure of the maximum amount of nutrients taken up by potatoes grown in Germany (4) showed that Ca is taken up by the plant the quickest, and SO_3 the slowest with K, Cl, N and P intermediate in the order given. No different effect was noted between KCl and K_2SO_4. The amounts of K or Ca taken up by the plant are dependent upon each other Therefore, an increase of 50 per cent in the K taken up by the plant following fertilization with K_2SO_4 was accompanied by a similar increase in the Ca absorbed. On an average the Ca taken up by the plant fell off to 34 per cent of the maximum toward the end of the season. The Cl and K fell off to 63 and 82 per cent respectively. Fertilization with KCl increased the absorption of Cl about 242 per cent as compared with 54 per cent for K_2SO_4. K absorption was increased more by KCl than by K_2SO_4. The nutrient materials absorbed stand in the ratio P:Cl:SO_3:K:Ca:N::1:0.79:0.72::3.22.4.48.4.77.

The same authors (3) reported that KCl increased yields to a greater extent than did K_2SO_4. The K and Cl contents of the potatoes varied directly with the potato and starch yields obtained in 1933.

Fertilization with KCl nearly doubled the Cl content as compared with fertilization with K_2SO_4.

Scharrer and Schropp (40) with pot experiments showed that K_2O fertilizers counteracted the unfavorable effects of insufficient light on yield of tubers and crude protein. Shaded plants contained more chlorophyll than those grown under normal light conditions.

Watson (50) stated that the application of KCl resulted in a marked reduction of sucrose in potato leaves during the middle of the day. Starches and reducing sugars were not affected. The rate of translocation of carbohydrates during the period of darkness

was unaffected by an application of KCl, but the rate of removal of dry matter was increased. It is suggested that the efficiency of the photosynthetic mechanism was increased by an application of KCl.

Baslavskaja (2) showed that large applications of chlorides to potato plants decreased the amount of carbohydrates in the leaves. This is probably caused by the lowered content of chlorophyll to each unit of leaf surface and a weakened photosynthetic activity. The leaves of plants receiving chlorides were relatively richer in starch than the leaves of the control series. This may be because of a retardation in the movement of starch from the leaves to the tubers or to the greater use of the soluble carbohydrates in the respiratory process.

On a silt loam soil in Arkansas, Cooper and Watts (15) report that potatoes appeared to need a fertilizer mixture of a 1-3-1 ratio and may be expected to respond profitably to as much as 1000 lbs. of 4-12-4. On other soils a 3-3-2 ratio proved best with as much as 800 pounds of a 12-12-7 fertilizer being profitable.

In a general summary of five years' work in five or six widely separated states Brown (11) shows that the side method of fertilizer placement invariably gave highest average yields for all locations.

Martin (28) obtained highest yields from side placement of fertilizer 2 inches on each side and about on a level with or a trifle below the seed piece plane. There was very little indication that the addition of limestone to an acid fertilizer was beneficial as measured by yields.

Chucka (14) noted that in Maine the yields obtained with the neutral fertilizers were somewhat higher than the yields obtained with the same placements with acid fertilizer. There was no response to amounts of fertilizer greater than 1500 pounds to each acre. This may partially be caused by the extremely hot, dry weather prevailing during July and August of 1935.

Four years' results show that placing the fertilizer in bands at the sides of the seed pieces is better than placing the fertilizer in a band below the seed pieces or mixing it with the soil.

Houghland and Strong (24) noted that several side placements of fertilizer produced equally good yields whereas placement of fertilizer underneath the seed piece has consistently caused lower yields.

In the ten-inch length broken band experiment there was a gradual increase in yield as the amount of fertilizer to the acre was increased from 1000 to 2000 pounds for each acre. Similar results were obtained from the five-inch length band.

Houghland and Smith (23) report that for two years experiments placements of fertilizer in the furrow, lightly mixed and that

on each side, 1 inch away on level with seed piece have given the highest yields on Long Island. Neutral fertilizers yielded the same as acid fertilizers.

With the ten-inch length broken band there were uniform increases in yields as the amount of fertilizer applied to the acre was increased from 1000 to 2000 lbs. per acre. With the five-inch length band the yields increased steadily from the 1000 pound rate but at 2000 pounds the yield dropped off sharply. The five-inch broken band application of 1750 pounds to the acre gave yields equal to those of the 2000 pound applications with the continuous band. These yield comparisons are particularly interesting because through them we get the first indication that broken band distribution may be effective in offsetting a lowered yield resulting from a small reduction in the total amount of fertilizers used on an acre of potatoes.

Nagy (30) found that an inadequate supply of potassium increases blackening of boiled potatoes by increasing the content of tyrosine and the activity of tyrosinase.

Thompson and others (48) present a review of muck soil problems and results of fertilizer and soil reaction experiments conducted in New York State during the past five years.

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POTATO BREEDING INVESTIGATIONS IN 1936: REVIEW OF LITERATURE

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This paper is a survey of potato breeding investigations in the United States and foreign countries as reported in the various papers

which have been published during the year 1936. A few papers not available at the time the last report was presented to this association are also included. Abstracts published by the Imperial Bureau of Plant Genetics, Cambridge, England, have been drawn upon for much of the foreign material.

Miscellaneous Studies

A paper by Bukasov (*3*), entitled "The problems of potato breeding," gives much general information regarding the characters of breeding value found in the South American wild and cultivated species.

In studies to determine the conditions favorable for the storage of potato pollen Kawakami (8) found the optimum relative humidity to be 15-20 per cent. Pollen stored under this condition of humidity retained its viability for fourteen days.

Experiments that were conducted to determine the effect of the length of the period of storage of the seed tubers on the abundance of flower production are reported by Miller (*10*). He found that, under Louisiana conditions, plants grown from tubers having a short storage period produced a larger number of flowers to each hill than the plants grown from tubers having a long storage period. This result was caused by the combined increase in the percentage of stalks bearing flowers, as well as the increased number of flower clusters to the stalk and the greater number of flowers in each cluster.

The effect of X-rays and other agencies in producing vegetative mutations in potatoes has been studied by Asseyeva and Blagovidova (*2*). Mutations were detected in some varieties with considerable frequency especially in material that was X-rayed. In the variety Wohltmann twenty-three leaf mutations were observed, whereas none was found in Epicure. Only one tuber mutation was obtained. Treatments of the tubers with various chemicals were tried but without effect.

Selection for increase in yield within each of several varieties was practiced by Wenk (*20*) for many years. No improvement was obtained by this means.

Cytology

Studies of the meiotic divisions in their relation to fertility were made by Ellison (*6*) in 50 British varieties of the cultivated potato. He concluded that the sterility of the potato is controlled primarily by the internal genetical factors which produce meiotic irregularities in

both anthers and ovules as well as irregularities in the development of the floral organs. These factors are highly susceptible to the effect of the environment so that although a variety may be fertile under certain conditions, it may be completely sterile under a different environment.

Genetic Studies

The results of a study of the inheritance of color in potato tubers have been reported by Krantz and Mattson (*9*). Red color in the periderm is assumed to be caused by the action of three complementary factors, E, S and F; red color in the cortex to the factors C, R and D; and blue color in both periderm and cortex to two duplicate factors, P and P^1, in addition to the factors concerned in the production of red in each of these areas.

Breeding for Protein Content

In a cross between two species, *Solanum phureja* and *S. rybinii*, containing 14.09 and 5.37 per cent protein, respectively, Schwarz and Kuzmin (*16*) obtained hybrids which exceeded *S. phureja* in protein content some having 15.68 per cent. Others, however, were as low as 8.53 per cent. The F_2 and back cross ratios indicated that the protein content was governed by several genes.

Breeding for Yield

Good yields have been obtained by Emme and Veselovskaja (*7*) from certain combinations of forms of *Solanum andigenum*. The results with interspecific crosses have led to the conclusion that yield is a genetic character although highly complex in nature.

The value of *Solanum andigenum* as a parent for the production of high yielding varieties has also been confirmed by the work of Bukasov and Lechnovitz (*4*), who obtained some of their highest yields from hybrids of this species with European varieties.

Tikhonov and Demidovic (*18*) found a wide range in the segregations for yield in the F_1 generations of a number of crosses far exceeding the parental limits. Frequency distribution curves show a marked asymmetry toward the lower yields which is interpreted as indicating that factors for low yield are dominant.

Disease Resistance

At the present time the greater part of the potato breeding work in nearly all countries centers around disease resistance. Evidence is rapidly accumulating which indicates that it is only a question of time when it will be possible to control practically all of the important potato diseases by growing resistant strains developed by breeding methods.

Yellow Dwarf.—In tests of seedling progenies by tuber-graft inoculation, Wheeler (*21*) found resistance to yellow dwarf manifested by several of the individual seedlings.

Veinbanding Mosaic—Tests for resistance to veinbanding mosaic have been reported by Vincent and Jones (*19*). In seedling progenies derived from crosses whose parentage included ten of the old commercial varieties all were highly susceptible. In four hundred and twenty strains of which Katahdin was a parent, twenty-two showed a high degree of resistance.

Late Blight—In a paper by Müller (*11*) it is pointed out that only certain varieties of *Solanum demissum* are resistant to the new strains of *Phytophthora infestans.* Schick and Lehmann—(13) and Schick and Schaper (*14*) found that some lines of this species are resistant to four of the Phytophthora strains, others are susceptible to these, whereas still other lines are resistant to part of these strains of late blight and susceptible to others. The authors last mentioned also reported that in certain segregating progenies resistance to late blight was dominant, whereas in others it was found to be recessive.

Stevenson et al. (*17*) have found that progenies obtained by inbreeding and crossing certain of the commercial varieties of *Solanum tuberosum,* possess a sufficiently high degree of resistance to late blight to enable them to withstand severe field epidemics without serious loss. Some of the resistant segregates also produce high yields.

Common Scab—Schlumberger (*15*) has reported the results of tests of a number of varieties for resistance to scab. Treff As ranked as highly resistant for a period of 3 years, and Frühauf, Rhodos and Weisses Rössl for a period of 2 years.

In tests of American and foreign varieties Clark et al. (*5*) found a very high degree of resistance to scab in a small number of European varieties. A moderate degree of resistance was found in other varieties of foreign origin and in a few American varieties. Seedling progenies in the test showed segregation for resistance to this disease in both russet-skin and white-skin types.

Frost Resistance

In Russia much attention is being given to the production of varieties that will withstand several degrees of frost. The various workers in this field have found that several of the species and forms obtained from South America possess this characteristic.

Rasumov (12) found *Solanum acaule* to be the most highly frost resistant of a large number of species tested, remaining undamaged at a temperature as low as 21.2° F. in the young stage. This resistance diminished, to some extent with the age of the plants. Other species possessing resistance greater than that of the cultivated potato are *S. ajanhuiri, S. curtilobum, S. juzepzucii, S. pacus, S. tacla* and *S. demissum.*

Resistance to frost in three other species, viz: *Solanum bukasovii, S. commersonii* and *S. millanii,* has been reported by Bukasov and Lechnovitz (4). These investigators also found that hybrids with *S. demissum* retain the frost resistance of this species but are low in yield. Some hybrids of *S. curtilobum* with the European potato, that are not only frost-resistant, but produce good yields and have a starch content as high as 26 per cent, have been obtained.

At the Krasnyi Pakhar station in northern Russia (1) it was found that hybrids obtained by crossing *Solanum acaule* with *S. ajanhuiri* and with *S. bukasovii* were very hardy, withstanding a temperature of 19.4° F. However, they were sterile and formed no tubers. Resistance to this relatively low temperature was also found in certain hybrids between *S. tuberosum* and *S. semidemissum.*

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SECTIONAL NOTES

Colorado

The condition of potatoes in Colorado was still about normal during July, but high temperature, lack of rainfall, and depleted supplies of irrigation water so far in August will mean lower yields, unless the rainfall for the balance of the month is considerably above normal. Psyllids are widely distributed over the state, but the population seems to be small, and spraying is taking care of the situation in nice shape.

The first field inspection has been completed on a large acreage of certified seed. The rejections for haywire and mosaic have been heavier than usual.

The annual Farmers' Day at the Mountain Substation was held the 12th of August and the potato work of the station was explained to approximately five hundred farmers.

The second annual meeting of the potato workers of Nebraska, Wyoming and Colorado was held in Colorado from the 7th to the 9th of August. The meeting started at the Mountain Substation of Colorado State College, where plots of fertilizer treatments, date of plant-

ing, soil treatment for scab and rhizoctonia control and new varieties and seedlings were viewed. Various diseases were also studied in the certified seed sample plots.

The second stop was at the breeding plots of the Colorado Station of the U. S. Department of Agriculture, located in Estes Park. Here various crosses and families were pointed out by W. C. Edmundson. A discussion of breeding methods and the value of certain parents was discussed. Scab-resistant varieties from Germany were also emphasized.

The third stop was at the Colorado Station of the U. S. Department of Agriculture at Greeley. Irrigation with well water and ditch water was compared. Various methods of handling seed, cold storage, greening, sprouted, unsprouted, freshly cut, suberized, and sun-exposed were compared on Rurals and Bliss Triumphs. Numerous seedlings produced by the station were examined. Dr. Raleigh explained the testing of the seedlings for resistance to Fusarium, and also a test on the spread of spindle tuber.

Dr. G. H. Starr, of the University of Wyoming, was elected president and plans were made to hold the 1938 meeting in Wyoming. (Aug. 11).—C. H. Metzger.

Indiana

The potato situation in Indiana is rather promising for this season, inasmuch as we have had some timely rains, good conditions at planting time, and from 90 to perhaps 98 per cent stand. The potatoes in the extreme southern section of Indiana are just emerging and a greater portion of this crop will be used for early planting next spring. The Cobbler variety seems to be the main variety with a few Katahdins on the side.

Seemingly, we are well supplied with potatoes, and growers reporting sales claim that they are getting from $1.25 to $1.50 for a hundred pound sack. Potatoes are retailing from $1.75 to $2.00 to the sack and I presume most of these are being used as leaders in the grocery business.

The leafhopper started out rather seriously but the better grower has been able to put on several sprays and at the present time I believe we have the leafhopper whipped. (Aug. 9).—W. B Ward.

Kentucky

The early promise indicated by splendid vines was not fully realized, because the season became dry too early for the potatoes

to mature fully. Yields of the better fields were about 155 bushels to the acre of U. S. No. 1 and approximately 30 bushels of No. 2, with quite a few culls, as one would expect from potatoes prematurely killed by dry weather. The quality was exceptionally good, the early watery growth not being in evidence at digging time.

The second crop is just beginning to emerge. The stands are better than usual, because the men have had ample opportunity to prepare their ground well. (Aug. 6).—John S. Gardner.

Maine

Prospects for a crop of splendid quality are very favorable at present (Aug. 14th). Although some blight damage has occurred the majority of the farmers have kept fairly good control by thorough spraying. Probably there never has been so thorough a job of spraying done as has been done this year. Sprayers and dusters have been kept in the field constantly; the memory of last year's experience is still vivid in the minds of all growers. Weather conditions this week have been favorable for the spread of blight but with few exceptions, it has not made very damaging headway.

The quality of tubers themselves, as found by digging isolated hills or by roguing, has indicated a crop of good type with dry and mealy cooking characteristics.

Vines are still remaining green even in the fields of early-planted Cobblers. Sufficient moisture has been present to keep the crop growing steadily. Some signs of ripening are in evidence, however.

The second inspection by representatives of the State Department of Agriculture has been completed, for the most part. The quality of certified seed available this year has probably never been excelled. Nearly all the seed producers made a special effort this spring to plant only the best seed available and the low disease readings generally found are good evidence of their success.

Plantings were made with seed spaced closely together which should be another helpful factor in the shipment of a better product this winter.

No figures are available, as yet, on the acreage finally approved for certification. It is now expected that the acreage of Certified Cobblers will be very similiar to that of last season. Green Mountains have been increased considerably with some increase in acreage with the Katahdins and Chippewas.

Maine will probably be shipping seed to the Argentine again this fall. The results secured last season were so favorable that the Argentine growers are interested in securing further supplies.

Considerable discussion is being heard concerning the marketing agreements. Growers are sincerely interested, quite gennerally, in a marketing agreement for Maine whether or not other states consider one. A hearing will be held by the last of the month to determine the desires of producers here.

Plans are being made for making a credit study of Aroostook County. Various public agencies are interested in a joint study to determine the following points: First, the past experience; secondly, present needs; and third, probable future trends. A thorough factual study should be very helpful in determining future credit policies.

Approximately 4,500 worksheets have been filed with the Agricultural Adjustment Administration. The response of growers has been very favorable, the majority of growers revising their farm program with resulting increased efficiency. (Aug. 14).—Frank W. Hussey.

Maryland

The digging of the early crop and the planting of the late crop of potatoes on the Eastern Shore have been completed. In most localities on the Shore yields were above normal and the quality was good.

The first field inspection for certification has just been completed at a high elevation in the Western part of the state. Most of the fields are in excellent condition and are very free from diseases and varietal mixtures. Nearly all fields inspected were Rurals, but there were a few fields of Irish Cobblers, Warbas, Katahdins and Chippewas. (Aug. 4).—R. A. Jehle.

Massachusetts

Present indications reveal that a crop of 2,394,000 bushels of potatoes from 17,000 acres will be harvested in 1937, compared with 2,415,000 bushels from 16,000 acres during last season.

The dry weather during July and early August has resulted in a heavy infestation of flea beetles, leafhoppers and aphids causing the mortality of the vines on poorly sprayed fields. Late Blight, prevalent at an earlier date than last year, has been temporarily checked during the dry period but remains a menace to Green Mountains. This disease is likely to reappear with later rains in the fields where spraying is not continued. Black leg has been more evident than usual this season.

Although the harvesting of Cobblers at present shows fairly good yields, the growers are hesitant to market at the present low prices,—approximately 75 cents per hundredweight. (Aug. 14).—Ralph W. Donaldson.

Nebraska

Harvesting of the early crop of potatoes has begun in the North Platte Valley. Both the yields and the quality are better than the average. Yields of more than 300 bushels to the acre have been obtained, and it is believed that the average yield will be approximately 225 bushels. Psyllids have caused very little damage to early potatoes. Flea beetles have been prevalent in the early crop, but have been controlled effectively by spraying, consequently worm-track in tubers is not at all serious. On the whole the potatoes are of good quality. A large spraying program to control flea beetles, psyllids, and Colorado potato beetles has been in progress on both the early and late crops of potatoes. The results of spraying have been beneficial chiefly in the control of flea beetles and Colorado potato beetles. Owing to the small number of psyllid insects present this year, apparently there has been little need for spraying with lime-sulphur to control "purple top." However the lime-sulphur has been used extensively. Early potatoes are selling from 65 cents to 80 cents per hundred. Nearly all the potatoes are being shipped by truck.

Late potatoes are in excellent condition in the North Platte Valley. Prospects now indicate that a bumper crop of late potatoes will be harvested because the stands are good. The weather conditions have been ideal for growth. In general, the crop will not suffer for lack of irrigation water, and insect damage is not likely to be serious. The worst insect, threatening the crop at this time. is the grasshopper, which is causing some damage in localized areas. The prevalence of diseases is not so severe as usual. Barring damage from hail or other calamitous factors which might result in general damage to the crop, a large production of both table and certified seed potatoes will be harvested this fall in the North Platte Valley. (Aug. 7).—Lionel Harris.

Since reporting the condition of Nebraska's potato crop during July, both the weather and the rainfall have been adverse in their effect upon the crop. Particularly no rainfall has been noted in the main part of the potato growing area during the past month and temperatures have been running above normal most of the time. The condition of the crop has been reduced materially since the previous

report. Although most of the fields would recover with rains in the near future, a great many fields are materially damaged at this time. We felt that the condition of the crop was approximately one hundred per cent normal during July but on the average has decreased to 60 to 75 per cent at this time. A continuation of the heat and drought will further reduce the crop. At this time there is no prospect of abatement of the heat and drought.

There is a slight demand for certified potatoes and growers are reluctant to offer any stock for future shipment until a crop is assured. A very few future contracts were made earlier in the season.

The work of inspection and certification of potatoes has progressed quite rapidly. The first inspection was completed earlier than it has been for a number of years because the crop advanced so rapidly under the favorable growing conditions. These very favorable conditions in the early part of the season have resulted in greater damage being caused by the drought because the large vines have burned and fired more severelly.

The final crop entered for certification is about eighty per cent of last year, being slightly in excess of eight thousand acres.

Insect pests abound in all potato fields and are quite difficult to control. Grasshoppers have caused the most serious trouble. Since the harvesting of the grain and the drying of pastures have caused the insect to move into potato fields in increasing numbers, some fields have been entirely stripped and more damage is occurring every day. (Aug. 16).—Marx Koehnke.

New Jersey

Approximately one-third of the New Jersey crop has been harvested. The yield is not so large as anticipated due largely to the hot, dry weather we have experienced. The grower is receiving 65 cents a hundred at the grader and 80 cents for graded, sacked potatoes meeting the U. S. No. 1 grade requirements at the loading station. The commercial grade is being sold at a reduction of ten cents. Nearly every car shipped out of the state this year is being government-inspected. On Thursday of last week the Federal Surplus Commodities Cooperation opened an office in Hightstown and started to purchase potatoes, paying 80 cents for U. S. No. 1 grade loaded on the car. (Aug. 16).—W. H. Martin.

New York

The first inspection of seed potatoes has been practically completed. Subject to revision the acreage entered is as follows: Cob-

blers, 181; Green Mountain, 449; Smooth Rural, 449; Russet Rural, 324; Katahdin, 97; Bliss Triumph, 100; Chippewa, 118; and others 90. About 60 acres have been rejected on the basis of samples. The diseases involved are leaf roll, yellow dwarf and spindle tuber. Rejections at first inspection have amounted to approximately 110 acres,—about one-half on account of mixture and one-half because of mosaic. The season has been favorable for inspection work. In the central and western part of the State, rainfall has been insufficient for the last month but, as yet, no damage has resulted. (Aug. 9).—K. H. Fernow.

North Dakota

In the eastern and central sections of North Dakota, we are expecting a normal potato crop, referring to certified seed as well as to table stock. In these sections, the acreage is about the same this year as it has averaged in recent years. The rainfall and other climatic conditions are about normal, also.

In the extreme western part of the state, the acreage has been reduced nearly one-half, and the yield from each acre will be at least slightly below normal.

According to present indications there is likely to be a slightly smaller acreage admitted to certification this year. This is because the rules have been made somewhat more strict and more of the fields are being eliminated by the inspectors.

We are expecting to find a good quality and also a good type of tuber this year, because normal weather conditions will not interfere as they did last year. Because of the deformed and small-sized tubers a year ago, this state established a second grade of certified seed potatoes under a red tag. This year there will be no second grade. All seed will have to measure up to blue tag specifications or it will not be certified. It is our plan to discontinue the use of a red tag or second grade in our certification system. (Aug. 9).—E. M. Gillig.

Ohio

There has been little change in the potato situation in Ohio during the month. Heavy rains have continued over most sections of the state and there has been some additional water damage to the late potato crop. (Aug. 14).—E. B. Tussing.

Rhode Island

The Cobblers have either been dug or are being harvested. The yields are very good. Hot, dry weather arrived just in time to

check, what seemed to be, a coming epidemic of late blight. Some fields have suffered considerably from lack of moisture but recent rains have helped the late crop. The Warba continues to do very well in the experimental plats, and appears to be a promising early variety for our state. (Aug. 14).—T. E. Odland.

Tennessee

We have had an unusually favorable growing season for the crops. The late crop Irish potatoes are just emerging; the early ones have been harvested and sold. A few midseason plantings show considerable blight. Although the prices are somewhat low, most of our growers are cheerful. (Aug. 9).—Brooks D. Drain.

Vermont

Extremely rapid growth during the hot period of July and early August has done much to make up for the late planting of potatoes. Stands appear to be extremely variable, even in the same localities and sometimes in the same fields where breaks occurred at the time of planting in the different sections. A typical case of this follows: one-half of a two-acre field planted on the 25th of May, 60 per cent stand; the other one-half planted on the 27th of May, using same seed stock, same fertilizer and same machine, showed 95 per cent stand.

Insect damage appears to have been comparatively light to date, especially in the case of leafhoppers. No late blight and very little early blight have been observed. Virus diseases, especially leaf roll and mosaic, have shown very clearly as might be expected in a moist season. They are both abundant in a high percentage of commercial fields planted from uncertified or unrogued stock. These diseases have also caused more rejections from certification than for the past several years.

Vermont Certified Seed Potato Growers' Association held its annual meeting at The Vermont State School of Agriculture, Randolph Center, on the 11th of August. Dr. C. F. Clark of the U. S. Bureau of Plant Industry, was the principal speaker from outside, and gave a very interesting talk on varietal development and improvement. As the only statewide organization of potato growers, the association also heard a report from its vice president, C. E. Cramton, on the recent AAA conference where Mr. Cramton represented Vermont. Detailed consideration will be given the recommendations at a Directors' meeting to be held in the near future.

A few more growers, with a slightly smaller acreage than last year is the tentative report on certified seed potato enrollment. The acreage totals about 550. (Aug. 13).—H. L. Bailey.

Washington

The potato acreage entered for certification during the present season is the largest it has been for years. Applications to date exceed 900 acres. The White Rose and Netted Gems are the principal varieties grown.

Conditions have been only fair for growing during the present season. We have just had a good rain which will add to our much needed supply of moisture, but it is likely to increase the hazard caused by late blight. We have already noted a severe infestation of late blight in Snohomish County and are rather fearful that this disease may take considerable toll if moist weather continues. Our commercial crop is estimated to range between 10 to 20 per cent above normal. (Aug. 9).—Chas. D. Gaines.

Canada

A total of 29,210 acres of potatoes is listed for inspection with a view to certification this season. This represents a 45 per cent increase in acreage to be inspected, as compared with last year. The acreage by varieties entered for inspection is as follows: Irish Cobbler, 10,608; Green Mountain, 13,003; Bliss Triumph 2,674; Katahdin, 766; Dooley, 663; Warba, 126; Chippewa, 73; and other varieties, 1,297 acres.

According to a report issued by the Dominion Bureau of Statistics, the condition of the crop on the 31st of July, 1937, as compared with that of the same date in 1936, is as follows: (100 = long time average yield per acre). The 1936 figures are in parentheses in each case. Canada, 92(81); Prince Edward Island, 95(96); Nova Scotia, 96, (99); New Brunswick, 98(99); Quebec, 101(99); Ontario, 96, (70;) Manitoba, 91, (55); Saskatchewan, 48, (59); Alberta, 80, (59); and British Columbia, 95, (97). (Aug. 13).—John Tucker.

REVIEW OF RECENT LITERATURE

Tuber cracking in Green Mountains. Reiner Bonde. (*Maine (Ann. Rpt.) Agr. Exp. Sta. Bul.* 380. (1935)).

When potatoes were harvested before the foliage was dead and the tubers had ripened, some cracking and bursting of the tubers occurred quite commonly. This was not the case in the

Irish Cobbler variety and in those Green Mountain fields which had matured early.

Field records reveal that only a small proportion of the tubers were cracked during the digging operation. The greatest proportion of the cracking occurred as the tubers were being dumped by the pickers from the basket into the barrels in the field. The tendency to crack decreased greatly from September 15 to October 18.

An examination of tubers revealed that nearly ninety per cent of the cracking was associated with bruises. Very often slight bruises and jars, such as occur in picking and dropping the potatoes into baskets, resulted in the tubers breaking open. This trouble disappeared as the season progressed and the tubers were allowed to harden and ripen off before being harvested.

Yield comparison between Green Mountain and Rust Proof

The Rust Proof variety is resistant to tuber rots and can withstand rust epidemics without being sprayed. In years when late blight was prevalent, this variety has yielded quite favorably in csomparison with other varieties.

In 1935 yield comparisons indicated that the Green Mountain variety was highly superior to the Rust Proof. This disease was practically absent in 1935.

The Rust Proof variety has been most valuable as a parent plant for use in breeding studies for resistance to late blight and other diseases.

Killing of potato vines with sulfuric acid to hasten maturity

In long growing seasons, such as 1935 in Aroostook County, many potato fields that have been well fertilized and sprayed continue to grow until killed by freezing temperatures. Growers who dug their crop while it was immature experienced large losses because of bruising and skinning of the green tubers. Still greater losses occurred on account of tuber cracking.

Spraying with a solution of commercial sulfuric acid was used as a method for killing potato tops and hastening the maturity of the tubers. The material was applied on September 6 and 12 and October 2. A 3½ per cent strength of sulfuric acid killed the tender leaves but the stalks remained green and were uninjured. A 5 per cent solution was much more effective and killed the leaves but also failed to injure the stalks. These were again sprayed one

week later with a 7 per cent solution. This second spray killed the remaining leaves and injured the stalks so that they died within a week. On October 2, a 12 per cent solution almost completely killed the foliage. The difference in kill, however, between the 6 and 12 per cent solution was not enough to warrant the use of the higher concentration.

Killing the foliage early in the season in seed plots may prevent the late spread of leaf roll and other virus diseases into the tubers of the seed stocks. Sulfuric acid also is an excellent weed killer and may be found to be very useful in destroying wild mustard and kale. Suitable attachments to the regular potato spray equipment are available for its use.—ORA SMITH.

Relation between quantity of ethylene chlorhydrin absorbed and growth response in treatments for shortening the rest period of potato tubers. L. P. MILLER and F. E. DENNY. (*Contrib. Boyce Thompson Inst. Vol.* 8, *No.* 2, (1936) *pp.* 121-136).

Dormant potato tubers were subjected to the vapor of ethylene chlorhydrin in closed containers for five day periods under such conditions that the amount of chlorhydrin taken up by the tubers varied over a wide range. It was therefore possible to determine the minimum concentration which was necessary to overcome the rest period and the maximum concentration which could be tolerated without serious injury.

On the basis of the quantities recovered from the tubers after treatment the effective range was found to vary from 15 cc. to less than 1 cc. 0.1 molar chlorhydrin to 100 grams of tubers at 30° C. and from 25 cc. to less than 1 cc. 0.1 molar solution at 25° and 22° C. Some chlorhydrin is also decomposed within the tubers during the five-day treatment so that the actual amount taken in probably amounts to several cc. 0.1 molar more than the quantity recovered unaltered at the end of the treatment.

POTATO MEETING

Sept. 10—Potato Field Day at Ohio Agricultural Experiment Station, Wooster.

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PROGRESS IN POTATO BREEDING

Many thousands of dollars are spent annually for chemicals and labor for the control of potato diseases. Despite this fact, the losses from diseases amount to enormous sums, particularly during those years when the potato crop is sold for a price nearly commensurate with its value in the diet. We have developed fairly satisfactory measures for the control of certain diseases of the potato, but there are others for which we have no adequate control measures. It is likewise true that, even though a number of our commonly grown varieties possess good quality, practically every one of them has certain characters for which improvement is needed.

The factors of disease resistance and improved quality can be obtained only through the development of new varieties. At a recent meeting of potato breeders, held in New York, Donald Reddick exhibited varieties which are immune to the late blight organism; and tubers, which were almost immune to scab infection, were exhibited by F. M. Blodgett. Progress has also been made by C. F. Clark and F. J. Stevenson, of the United States Department of Agriculture, and by F. A. Krantz, of the University of Minnesota, in the development of varieties which are resistant to certain of the virus diseases and which are superior in appearance to our present varieties. Mention must be made also of William Stuart's contribution to the potato breeding program.

All these developments are encouraging and it is safe to say that we will soon have potato varieties which will be superior to those we now grow. Progress has necessarily been slow. Much progress has been made, however, and the plant breeders interested in developing new varieties of potatoes should have the support of the industry. There is no sounder way in which to prepare for better times than to develop a potato which is resistant to disease and which, as the result of its superior quality, will result in an increase in demand on the part of the consumer.